Stepped calander

The present invention relates to a calender according to the preamble of claim 1 comprising at least two calender nips, each of them comprising a soft roll and a hard roll, for surface-treating a moving web of paper or paperboard.

Different types of calenders are used for improving the smoothness and surface profile of manufactured sheet of paper or board. One of the concurrent calender types is the soft-nip calender conventionally comprising at least two calender nips operating in succession along the web travel, whereby each nip is formed by a soft roll and a hard roll mounted to rotate above one another. Today, the soft roll is generally surfaced with a polymer coating, while the hard roll is a heatable metallic roll. The different types of rolls are mounted as an alternating succession in a vertical stack thus forming successive nips, whereby either side of a running web travels alternately over a soft roll, a hard roll and so on, thus making both sides of the sheet maximally equal after the surface treatment. When a product specified for unequal sidedness is being made, the web can be treated differently for either side by way of arranging the soft rolls on one side of the web and, respectively, the hard rolls on the other side of the web. The calender rolls, particularly the soft roll, undergo wear during the use, thereby invoking a need of scheduled replacement. Today, two different techniques of roll replacement are chiefly used. In one arrangement, the old roll with its bearing housings is elevated away from its operating position by means of an overhead hoist. Herein, either the upper roll must always be removed before the lower roll can be replaced or, alternatively, the rolls of the nip must be mounted staggered in regard to the vertical plane in order to facilitate a sideways obliquely performed lifting away of the lower roll from its normal position under the upper roll. Also in calenders comprising vertically superposed roll stacks only the lower roll can be removed in a lateral direction by first shifting the lower roll laterally away from under the upper roll. In this type of construction, the frame of the calender stack must be open at least in the direction of the lower roll removal. In practice, the calender frame is made open toward the roll servicing side and, moreover, sufficient space about the calender

sides must be reserved for roll replacement.

When the construction is such as to allow the lower roll to be removed only after the removal of the upper roll, the roll replacement operation becomes extremely clumsy, particularly if the upper roll is a heatable roll, as is the case inevitably always for the second nip, because the roll connections such as those of the heating medium circulation must be disconnected during the removal of the roll. In a roll replacement system with a lateral transfer of the rolls, sufficient free space must be reserved for the removal of either roll. Such servicing space for roll replacement requires more footprint about the calender. As the roll diameters in modern papermaking machines are large, the headroom for roll replacement may be as large as two meters per roll and, since a calender always has at least two calender nips, the need of lateral footprint may be up to four meters for a two-nip calender. Obviously, this kind of roll mounting is not possible in such machinery rebuild operations wherein a soft-nip calender must be fitted to replace an outdated machine calender. During machinery rebuild, it may be necessary to relocate various units of the papermaking machinery and increase the length of the machine, which is expensive. Also in new factory projects, a machine of a larger overall length increases costs due to larger footprint, among other factors. Another drawback of a large lateral roll change space is that the web being treated must be passed unsupported as an open draw over the roll change space, because this portion of machinery cannot be equipped with auxiliary devices. Long, open web draws increase the risk of web breaks and complicate web tail threading.

It is also possible to replace the lower roll of a calender nip by way of elevating the upper roll apart from the lower roll and then moving the lower roll with its bearing housings aside supported by a roll transfer carriage, whereupon the roll can be replaced. This arrangement is hampered by the large lateral space required about the roll and its need for a dual set of roll handling equipment, whereby the lift must be complemented with at least two transfer carriages, which makes this construction costly.

Attempts have been made to reduce the space requirement of the calender in the

machine direction of the web travel by way of, e.g., locating the calender frames of two successive roll nips, the frames having one open side, in a back-to-back disposition of the frames by their closed sides, whereby the web travel between the successive nips is maximally minimized. While this arrangement needs a smaller layout footprint, a problem arises from the roll replacement operations that now must be performed on opposite sides of the calender frame thus still needing as much roll change headroom as in any other conventional calender.

The calender footprint can be reduced by locating the roll nips on the same side of the calender frame, however, with the center axes of the roll nips staggered laterally in regard to each other. Herein, the frame is made open on the roll servicing side. Then, the replacement of the lower rolls takes place by first slightly elevating the upper roll of the nip and then transferring the lower roll aside on the open side of the calender frame. In the present construction, the lower roll of the lower nip is removed by simply first elevating the upper roll of the nip. Obviously, this arrangement needs a relatively large headroom in the vertical direction inasmuch as the upper pair of rolls must be situated so high that the lower roll of this pair can be removed over the upper roll of the lower pair of rolls without colliding the rolls with each other.

It is an object of the present invention to provide an entirely novel type of calender construction capable of overcoming the problems of the prior art techniques described above.

The goal of the invention is achieved by way of disposing two successive calender nips so that the mutual distance between the lower rolls of the successive nips is smaller than the mutual distance between the upper rolls of the nips, whereby the rolls of the nips as seen from their ends are disposed in a V-angled configuration and, furthermore, the roll pairs of the nips are adapted to a calender frame open from the service side of the roll nips in such a configuration that a height difference is formed between roll pairs of the nips.

The web moisturizing or steaming equipment are advantageously located just

upstream in front of the nips in such a fashion that the web passes immediately after moisturizing/steaming into the calender nip.

More specifically, the calender according to the invention is characterized by what is stated in the characterizing part of claim 1.

The invention offers significant benefits.

By virtue of the invention, it is possible to gain a substantial reduction in the footprint occupied in the machine direction by a calender such as a soft-nip calender or the like comprising a plurality of separate roll nips. The invention also facilitates a simple replacement of the lower rolls. Owing to its minimal footprint need, a calender according to the invention is aptly suited for machine rebuilds intended, e.g., to improve the quality of the manufactured product with the help of a more efficient calender. A calender according to the invention may even be fitted to replace a single-stack machine calender in places where prior-art calender constructions could not necessarily be squeezed onto the footprint left free by a dismantled two-stack machine calender. Furthermore, the length of open web draws remains short and the number of guide rolls is smaller than in conventional calender constructions. It is even possible to design the entire calender into an integrated unit that can be shipped to a customer and rapidly mounted on site as a replacement of an existing calender or as a part of new machinery being erected.

Most typically, the roll to be replaced is the roll with the compliant covering. According to the invention, the soft roll of the upper roll nip is placed under the hard roll. Then, the soft roll is replaced by moving the roll in the direction of the lower pair of rolls and subsequently elevating the roll after it has been removed from below the upper roll. Due to the V-angled disposition of the roll pairs, the transfer distance of the soft roll of the upper pair of rolls does not need much headroom in the lateral direction thus allowing the arrangement of the roll nips close to each other in the machine direction of the calender. The nips may also be situated close each other in the vertical direction, because in the present configuration there is no need to have

the lower roll of the upper pair of rolls to be located above the upper roll of the lower pair of rolls, at least not entirely. Also in the lower pair of rolls the soft roll is the upper roll that can be removed by lifting it directly upward thus disposing with the need for any extra headroom in the replacement of this roll. Inasmuch as the heated roll of the lower roll nip is rarely replaced and its replacement may be carried out in conjunction with the replacement of the soft roll, also the removal of the lower roll of the lower roll nip can be made by a direct upward lift after the removal of the upper roll. Hence, the footprint need of roll replacement operations is equal to the installation footprint of the calender itself.

The auxiliary equipment, particularly the moisturizing/steaming devices, of the calender can be located close to the calender nips where their effect is most pronounced. Moreover, open web draws remain short thus contributing to reduced risk of web breaks and substantially easier web tail threading.

In the following, the invention will be examined with the help of an exemplifying embodiment by making reference to the appended drawing. The drawing shows a schematic diagram of a calender construction according to the invention.

As shown in the diagram, a calender 1 is located downstream of a dryer cylinder group 2. The dryer cylinder group 2 may be the dryer cylinder group or the like section of paper or board machine or, alternatively, of an off-line coater. Without construction modifications, the calender itself may be adapted integral with any web making or treating section without implementing any major changes in the section, and the calender may be arranged to operate, e.g., between the dryer group of a papermaking machine and a coater section. In the exemplifying embodiment, a web 3 is passed from the calender to an winder 4. The frame of the calender 4 is stairwise staggered so as to comprise two levels 6 and 7 on which the roll nips are adapted. Each one of the roll nips comprises a heated thermoroll generally having a steel shell and a soft roll generally covered with a polymer coating. In the lower pair of rolls, lower roll 8 is a thermoroll and upper roll 9 is a soft roll. On the outgoing side of the roll nip, thermoroll 8 is equipped with a doctor 10 serving to keep the roll surface

clean. The soft roll 9 is adapted in an offset staggered position from above the thermoroll 8 so that the soft roll 9 is situated laterally more outwardly than the thermoroll 8 in the frame 5. A steaming or moisturizing device 11 is adapted to operate just in front of the nip formed between the rolls 8, 9. Web 3 is passed into the nip between the rolls 8, 9 by means of a guide roll 12 located in front of the moisturizing device. As the soft roll has been offset slightly outward, sufficient space is provided for the guide roll 11 and the moisturizing device thus allowing the placement of the moisturizing device close to the roll nip. Respectively, the web can readily pass between the lower pair of rolls and the upper pair of rolls, whereby the passage of the web can be readily guided by two guide rolls 12, 13 from the upper pair of rolls to the lower pair of rolls.

In the upper pair of nip rolls, soft roll 4 is situated below and thermoroll 15 on top. Also here, thermoroll 15 is offset from the center axis of the soft roll 14 close to the calender frame 5 and the soft roll 14 situated in the lower position is closer to the lower roll pair 8, 9. Hence, the rolls of the nips are disposed in a V-angled configuration and staggered at different levels in regard to each other. As a result, the center axes of the lower rolls in each respective pair of rolls are closer to each other than the center axes of the upper rolls. Also in the upper pair of rolls, the thermoroll 15 is equipped with a cleaning doctor 16 and a moisturizing/steaming device is placed in front of the roll nip.

Without departing from the scope and spirit of the invention, embodiments different from those described above may be contemplated.

While only a soft-nip calender is discussed above as an example of calender types, the invention can as well be applied to all such calenders that include at least two calender nips formed by at least two rolls. The angle between the inclined roll nip stacks, that is, the V-angled disposition between the adjacent roll nip stacks can be varied, however, not making the V-angle smaller than what is necessary to ensure unobstructed removal of the lower roll from below the upper roll. The required inclination between the rolls nip stacks is determined by such factors as the outer

dimensions of the rolls and their bearing housings. Typically, a line drawn through the centers of the upper roll and the lower roll is inclined by 15° in regard to the vertical plane. The number of roll nips may be greater than two, whereby each twin pair of roll nips needs two roll change spaces and so upward according to the increasing number of roll nips in the calender. The number of rolls in a single assembly of nips may also be larger, whereby a typical arrangement is to use three rolls in a stack.

The difference between height levels of the roll pairs is determined by the installation space available. Generally in most cases the space available in the machine direction is more constrained than the headroom vertically available above the machine. Then, the present arrangement having the roll pairs staggered laterally and vertically in a stairwise V-angled configuration gives a very short calender construction due to strongly interlaced placement of the calender rolls. When desired, the upper pair of rolls may be situated entirely above the lower pair of rolls. As a result, the invention makes it possible to optimize the usage of available installation space very tightly, which is a great benefit in retrofit and improvement projects carried out on existing machinery.